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*Publication date:*  
2011

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Kádár, Z., Christensen, A. D., Oleskowicz-Popiel, P., Heiske, S., Thomsen, M. H., & Schmidt, J. E. (2011). *Biofuels in organic farming*. Poster session presented at 19th European Biomass Conference and Exhibition, Berlin, Berlin, Germany.

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# Biofuels in organic farming

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## Introduction

The presented study contributes to the development of decentralized biorefinery concepts (Figure 1) to be applied in the organic agricultural industry in Denmark, by integrating energy production (biogas and bioethanol) in organic farming, increasing the sustainability and energy self-reliance of organic food production systems.

In this work, a method for bioethanol production from rye and wheat grain was developed by utilizing the inherent amylase activity from germination of the seed. Simultaneous Saccharification and Fermentation (SSF) was performed to reduce end-product inhibition of the amylases during ethanol fermentation. Using organic cheese whey as a cheap nutrient source minimized the use of water and chemicals aiming at reduced process costs.

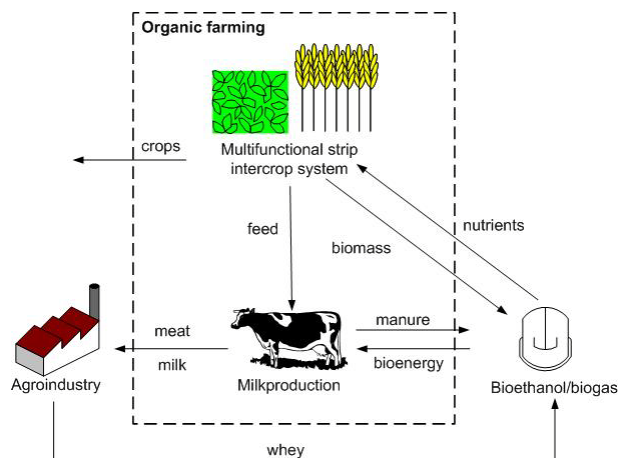
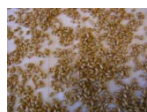


Fig. 1 Concept of bioenergy production in organic farming

## The process



germinated grain



whey

Prehydrolysis

50°C, 24h, pH4.8



Fermentation - SSF

*K. marxianus* DSMZ 7239



Ethanol



DDGS? <--- „Residues” ---> Biogas?

## Results

- Germinated grain can be used as raw material in bioethanol production by producing in-situ enzymes.
- Nutrient cost for ethanol production could be reduced by using cheese whey.
- The ethanol fermentations were completed by 190 h.
- Rye grain with high AAQ (autoamylolytical quotient) values were found to be suitable for autoamylolytical processes.
- The process is strongly dependent on the efficiency of the germination step.
- Wheat was not found to be a feasible substrate for inherent enzyme production.

## Acknowledgements

The work was financially supported by International Centre for Research in Organic Food Systems (ICROFS). Ingelis Larsen and Annette Eva Jensen are thanked for technical assistance on our work and the Fejér Megyei Nóvény- és Talajvédelmi Állomás (Velence, Hungary) for providing wheat samples. Poul Pedersen and Mogens Poulsen, Thise Dairy, Thise Denmark are thanked for providing organic whey and for cooperation on this project.